"EFFECTIVENESS OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION ALONG WITH MOTOR RELEARNING ON IMPROVING FUNCTIONAL MOBILITY IN SUBJECTS WITH SUB-ACUTE STROKE"

A Dissertation Submitted to

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9/1 KEERANATHAM ROAD,

SARAVANAMPATTY

COIMBATORE – 641 035

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Under the guidance of

Prof.Dr.M.SANKAR SAHAYARAJ M.P.T (Neurology), PGDSPT, TTCY, MIAP.

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Dissertation Evaluated on _____

Internal Examiner **External Examiner**

CERTIFICATE I

This is to certify that the dissertation entitled **"EFFECTIVENESS OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION ALONG WITH MOTOR RELEARNING ON IMPROVING FUNCTIONAL MOBILITY IN SUBJECTS WITH SUB-ACUTE STROKE "** is a bonafide compiled work, carried out by **Register No: 271420203 ,** PPG College of Physiotherapy,Coimbatore-641035 in partial fulfilment for the award of degree in Master of Physiotherapy as per the doctrines of requirements for the degree from **THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY, CHENNAI-32.** This work was guided and supervised by **Prof.Dr.M.SANKAR SAHAYARAJ M.P.T (Neurology), PGDSPT, TTCY, MIAP.**

DATE: **Prof.Dr.KS.RAJA SHENTHIL M.P.T (Cardio-Resp)., MIAP.,(PhD).,**

PLACE: **PRINCIPAL**

CERTIFICATE II

This is to certify that the dissertation entitled **"EFFECTIVENESS OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION ALONG WITH MOTOR RELEARNING ON IMPROVING FUNCTIONAL MOBILITY IN SUBJECTS WITH SUB-ACUTE STROKE "** is a bonafide compiled work, carried out by **Register No: 271420203,** PPG College of Physiotherapy,Coimbatore-641035 in partial fulfilment for the award of degree in Master of Physiotherapy as per the doctrines of requirements for the degree from **THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY, CHENNAI-32,** under my guidance and direct supervision.

DATE:

PLACE:

Prof.Dr.M.SANKAR SAHAYARAJ

M.P.T (Neurology), PGDSPT, TTCY, MIAP.

PROFESSOR

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CONTENTS

LIST OF TABLES

LIST OF GRAPH

ABSTRACT

"EFFECTIVENESS OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION ALONG WITH MOTOR RE-LEARNING ON IMPROVING FUNCTIONAL MOBILITY IN SUBJECTS WITH SUB-ACUTE STROKE"

Aim of the study: The study is aimed to investigate the effectiveness of Proprioceptive neuromuscular facilitation along with motor relearning on improving functional mobility in subjects with sub-acute stroke.

Objectiveof the study: The objective of the study is to enlighten the effectiveness of Proprioceptive neuromuscular facilitation along with motor relearning in improving functional mobility in subjects with sub-acute stroke

Methodology:

Study design: Experimental study design.

Sample size: 30 subjects with sub-acute stroke with functional mobility impairment were selected.

Procedure: Thirty subjects aged 45 to 55 years with stroke under Brunnstrom recovery stage III and IV were selected and assigned into two groups control group and experimental group with 15 subjects each, control group received PNF and the experimental group received PNF along with motor relearning program for a period of 4 weeks.

Outcome measures: Extended timed up and go test (ETUG) was used to evaluate the functional mobility before and after the treatment.

Results&Conclusion: The paired t test was used for within group analysis. The t values of control group for ETUG components sit to stand, walk 1, turn, walk 2, turn sit, walk speed ware21.469, 9.234, 35.133, 11.259, 14.587, 29.077 and p value were 0.00 through SPSS. 17 version.

The paired t test was used for within group analysis. The t values of experimental group for ETUG components sit to stand, walk 1, turn, walk 2, turn sit, walk speed were 19.795, 21.500, 15.985, 14.343, 18.189, 26.858 and p value were 0.00through SPSS. 17 version. The result showed significant improvement in within group analysis.

The unpaired t test was used to analyse between groups. The F value of ETUG components walk 2 and turn sit ware 4.731, 8.217 and p value of the same were 0.038, 0.008 respectively. The result showed that there were significant difference between control and experimental group in walk2 and turn to sit components

Hence it can be concluded that PNF along with motor relearning show improvement in functional mobility that subjects treated with PNF alone.

Key words: Motor re-learning, PNF, Brunnstrom recovery stage, ETUG, Sub-acute stroke.

CHAPTER I

INRODUCTION

1.1 BACKGROUND OF THE STUDY:

Ischemic stroke refers to an episode of neurological dysfunction, i.e., clinical evidence, due to focal cerebral, spinal or retinal infarction; infarction is based on objective evidence. In other words, stroke is characterized by symptoms, and the 24-hour time line is not mandatory if there is objective evidence of CNS infarction.[1]

Ischemic stroke is characterized by the sudden loss of blood circulation to an area of the brain, resulting in a corresponding loss of neurologic function. Acute ischemic stroke is caused by thrombotic or embolic occlusion of a cerebral artery and is more common than hemorrhagic stroke.[2]

1.2 INCIDENCE:

Cerebrovascular disorders (CVD) are increasing in prevalence and incidence in India due to rapid escalation of risk factors including hypertension diabetes mellitus, smoking and obesity affecting considerable proportion of adult population.

Global Burden of Disease study shows that of the 9.4 million deaths in India, 619,000 were due to stroke and Disability Adjusted Life Years (DALYs) lost were 28.5 million highlighting the fact that CVD leads to considerable mortality and morbidity.[3]Therefore there is likely to be a major crisis in India unless national measures to prevent/control risk factors of CVD are instituted and adequate services are put in place for the management and rehabilitation of stroke.[4] Another issue of concern is that 20-30% of strokes occur in people younger than 45 years and is more frequently seen in India compared to the west.[4]

The overall annual incidence rates are available only from few regions in the country; the rates per 100000 populations varied from 13 in Vellore [5] 33 in Rohtak [6] to 36/100000 in Kolkata.[7] The age adjusted rate per 100000 persons was 105 in Kolkata, [7] 135 in Trivandrum (based on Trivandrum stroke registry),[8] and 152 for Mumbai (based on "Mumbai Stroke Registry) [9] which are similar to incidence rates/100000 of China (in three

cities 76 to 150/100000),[10] and also as in developed countries including Perth (160), South London (130/100000).[11] In view of the problems of determining the actual burden of strokes in developing countries, particularly in view of rising trend in low-income and middle-income countries, [12] stepwise approach has been proposed by WHO to facilitate standardized approach to data collection and surveillance.[13],[14] The strategy essentially consists of three steps: Outcome of stroke patients in hospital, fatal events in the community and non-fatal events in the community and it is envisaged that this approach will provide the framework for creation of registries.[12],[13],[14] A multicentre study "Indian Collaborative Acute Stroke Study (ICASS)" based on step approach was initiated in seven cities and this experience has led to concept of establishing registries.[4],[8],[15],[16] Currently feasibility studies are underway for urban and rural registries under the aegis of ICMR with the goal to develop National stroke registry.[17]

Many patients remain unable to walk or have difficulties with walking after stroke. The ability to walk independently is a prerequisite for many daily activities. [18] It has been reported that only a small proportion can walk with sufficient ability to function effectively within the community.[19] Hemiplegics patients have been shown to bear a greater percentage of body weight on the sound limb, than on affected side.[20]

In persons with hemiplegic, posture, tone and coordinate reciprocal movements, which are required for normal gait, are usually impaired. Normal reciprocal pelvic movement is often replaced by a fixed pelvic retraction, which makes it difficult for patients to swing the affected lower extremity forward [21]. Co-ordination between moving body parts is essential for functional walking and is modified, often in a subtle manner, to accommodate variation in task requirements and circumstances, such as walking speed,n path curvature, and environmental clutter.[22]

Proprioceptive Neuromuscular Facilitation (PNF) is one approach commonly used to improve the gait of patients with hemiplegia. Various PNF procedures have been used, depending on the affected site. Among these PNF techniques is facilitation of pelvic motion to improve control of the pelvis. Because the pelvis has been described as a “key point of control” for maintaining a gait pattern, techniques designed to affect the pelvis are widely used [21]. The Rivermead Mobility Index (RMI) is a PRO instrument that measures mobility, an important

aspect of daily functioning in patients after stroke, and is being used increasingly for international research in patients with stroke.

Carr and Shepherd advocated that rehabilitation involve training of everyday actions using information from movement sciences, particularly the fields of biomechanics and motor learning, as well as knowledge of the pathology and impairments associated with stroke. Moreover, Carr and Shepherd have suggested that training can be organized into a circuit with a series of workstations designed to strengthen affected muscles and provide the opportunity for task practice.[23,24,25,26,27]

1.3 NEED OF THE STUDY:

Stroke is one of the main causes for impairment or decrease in functional mobility. Many studies have proven effectiveness of various techniques to improve functional mobility. PNF and Motor relearning program are one among them.

Conventional therapy, PNF along with motor relearning is a new concept to improve functional ability. There are very less studies to prove the effectiveness of conventional therapy, PNF along with Motor relearning to improve the functional mobility of subjects with stroke.

In India there is lack of studies to improve functional mobility in subjects with stroke by using conventional therapy, PNF along with Motor re learning, so the need of this study is to find out the effectiveness of conventional therapy, PNF and Motor relearning program in improving functional mobility of subjects with stroke.

1.4 AIM OF THE STUDY:

The study is aimed to find out the effectiveness in improving functional mobility in subjects with stroke by using Conventional therapy, PNF along with motor relearning program.

1.5 OBJECTIVE OF THE STUDY:

To find out the effectiveness of conventional therapy along with PNF in improving the functional mobility of subjects with stroke.

To find out the effectiveness of conventional therapy along with PNF and Motor relearning in improving the functional mobility of subjects with stroke

To compare the effectiveness of conventional therapy along with PNF and conventional therapy along with PNF and Motor relearning in improving the functional mobility of subjects with stroke.

1.6 HYPOTHESIS

NULL HYPOTHESIS:

There is no significance difference between of conventional therapy along with PNF and Motor relearning on improving functional mobility in subjects with MCA stroke

ALTERNATE HYPOTHESIS:

There is significant difference between of conventional therapy along with PNF and Motor relearning on improving functional mobility in subjects with MCA stroke

1.7 OPERATIONAL DEFINITIONS:

STROKE:

Cerebro-vascular diseases can be defined as those in which brain disease occurs secondary to a pathological disorder of blood vessel or blood supply.

PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION:

Hastening the response of the neuromuscular mechanism through stimulation of the proprioceptors; could result in either facilitation or inhibition.

MOTOR RELEARNING:

Motor relearning program is a set of process associated with practice or experience leading to relatively permanent changes leading in the capability for movement. This process employs unassisted, goal directed practice.

FUNCTIONAL MOBILITY:

Functional mobility can be defined as the manner in which people are able to move around in the environment in order to achieve daily activities and interact with society

EXTENDED TIMED UP AND GO TEST:

The ETGUG test is a practical, objective, assessment tool that can be used in almost any clinical setting with minimal equipment, professional expertise, or training. Additionally, it has the capacity to give the clinician more information since it measures each of the component parts of the test. The scope of application of the test might be enlarged to include implications for prevention strategies in the high-risk geriatric population and in guiding treatment more specifically.

CHAPTER II

REVIEW OF LITERATIRE

2.1 REVIEW FOR STROKE AND FUNCTIONAL MOBILITY:

1. **Alex Pollock "et al" 2015** conducted study on the Physical Rehabilitation Approaches for the Recovery of Function and Mobility after Stroke Major Update. A total of 96 studies (10,401 participants) in this review. More than half of the studies (50/96) were carried out in China. Generally the studies were heterogeneous, and many were poorly reported. Physical rehabilitation was found to have a beneficial effect, as compared with no treatment, on functional recovery after stroke (27 studies, 3423 participants; standardized mean difference (SMD) 0.78, 95% confidence interval (CI) 0.58 to 0.97, for Independence in ADL scales), and this effect was noted to persist beyond the length of the intervention period (nine studies, 540 participants; SMD 0.58, 95% CI 0.11 to 1.04). Subgroup analysis revealed a significant difference based on dose of intervention (P value < 0.0001, for independence in ADL), indicating that a dose of 30 to 60 minutes per day delivered five to seven days per week is effective. This evidence principally arises from studies carried out in China. Subgroup analyses also suggest significant benefit associated with a shorter time since stroke (P value 0.003, for independence in ADL). We found physical rehabilitation to be more effective than usual care or attention control in improving motor function (12 studies, 887 participants; SMD 0.37, 95% CI 0.20 to 0.55), balance (five studies, 246 participants; SMD 0.31, 95% CI 0.05 to 0.56) and gait velocity (14 studies, 1126 participants; SMD 0.46, 95% CI 0.32 to 0.60). Subgroup analysis demonstrated a significant difference based on dose of intervention (P value 0.02 for motor function), indicating that a dose of 30 to 60 minutes delivered five to seven days a week provides significant benefit. Subgroup analyses also suggest significant benefit associated with a shorter time since stroke (P value 0.05, for independence in ADL). No one physical rehabilitation approach was more (or less) effective than any other approach in improving independence in ADL (eight studies, 491 participans; test for subgroup differences: P value 0.71) or motor function (nine studies, 546 participants; test for subgroup differences: P value 0.41). These findings are supported by subgroup analyses carried out for comparisons of intervention versus no treatment or usual care,

which identified no significant effects of different treatment components or categories of interventions. [28]

2. **Beyaert C "et al" 2015** conducted a study on Gait post-stroke: Pathophysiology and rehabilitation strategies. We reviewed neural control and biomechanical description of gait in both non-disabled and post-stroke subjects. In addition, we reviewed most of the gait rehabilitation strategies currently in use or in development and observed their principles in relation to recent Pathophysiology of post-stroke gait. In both non-disabled and post-stroke subjects, motor control is organized on a task-oriented basis using a common set of a few muscle modules to simultaneously achieve body support, balance control, and forward progression during gait. Hemiparesis following stroke is due to disruption of descending neural pathways, usually with no direct lesion of the brainstem and cerebellar structures involved in motor automatic processes. Post-stroke, improvements of motor activities including standing and locomotion are variable but are typically characterized by a common postural behavior which involves the unaffected side more for body support and balance control, likely in response to initial muscle weakness of the affected side. Various rehabilitation strategies are regularly used or in development, targeting muscle activity, postural and gait tasks, using more or less high-technology equipment. Reduced walking speed often improves with time and with various rehabilitation strategies, but asymmetric postural behavior during standing and walking is often reinforced, maintained, or only transitorily decreased. This asymmetric compensatory postural behavior appears to be robust, driven by support and balance tasks maintaining the predominant use of the unaffected side over the initially impaired affected side. Based on these elements, stroke rehabilitation including affected muscle strengthening and often stretching would first need to correct the postural asymmetric pattern by exploiting postural automatic processes in various particular motor tasks secondarily beneficial to gait. [29]

3. **Hollands KL "et al" 2015** conducted a study on A novel and simple test of gait adaptability predicts gold standard measures of functional mobility in stroke survivors. Stroke survivors (n=42) stepped to targets, on a 6m walkway, placed to elicit step lengthening, shortening and narrowing on paretic and non-paretic sides. The number of targets missed during six walks and target stepping speed was recorded. Fugl-Meyer (FM), Berg Balance Scale (BBS), self-selected walking speed

(SWWS) and single support (SS) and step length (SL) symmetry (using Gait Rite when not walking to targets) were also assessed. Stepwise multiple-linear regression was used to model the relationships between: total targets missed, number missed with paretic and non-paretic legs, target stepping speed, and each clinical measure. Regression revealed a significant model for each outcome variable that included only one independent variable. Targets missed by the paretic limb, was a significant predictor of FM . Speed of target stepping was a significant predictor of each of BBS. No variables were significant predictors of SL or SS asymmetry. Speed of target stepping was significantly predictive of BBS and SSWS and paretic targets missed predicted FM, suggesting that fast target stepping requires good balance and accurate stepping demands good paretic leg function. The relationships between these parameters indicate gait adaptability is a clinically meaningful target for measurement and treatment of functionally adaptive walking ability in stroke survivors. [30]

4. **L. Brewer "et al" 2014** conducted a study on Stroke rehabilitation: recent advances and future therapies despite advances in the acute management of stroke, a large proportion of stroke patients are left with significant impairments. Over the coming decades the prevalence of stroke-related disability is expected to increase worldwide and this will impact greatly on families, healthcare systems and economies. Effective neuro-rehabilitation is a key factor in reducing disability after stroke. In this article we have reviewed and discussed the effects of stroke, principles of stroke rehabilitative care and predictors of recovery. We also have also discussed on novel therapies in stroke rehabilitation, including non-invasive brain stimulation, robotics and pharmacological augmentation. Many trials are currently underway, which, in time, may impact on future rehabilitative practice. [31]

2.2 REVIEW FOR MOTOR RELEARNING PROGRAME:

5. **Rajesh Verma "et al" 2011** conducted study to evaluate the effectiveness of the task-oriented circuit class training (TOCCT) with motor imagery (MI) on the gait during the sub acute phase after a stroke. 30 subjects with 4 – 12 weeks after stroke was randomized into 2 groups and outcome measures were measured by Functional ambulation classification (FAC), the Rivermed Visual Gait Assessment (RVGA), Step Length Asymmetry, Walking speed and 6 min walk test. Result showed positive

improvement in mean and median scores of the experimental group. The study conclude Task-oriented circuit class training with Motor imaginary produces statically significant and clinically relevant improvements in gait and gait related activities. [32]

6. **Mohamed Elsayed Khallaf "et al" 2014** conducted the study to find the effect of task specific exercises, Gait training and visual feedback of equinovrous gait among the individuals with stroke. 16 subjects with ischemic stroke were assigned in 2 groups. The subjects are at the stage 4 of motor recovery of foot according to chedoke Mc master stroke assessment. Significant improvements were observed among group 1 who received task specific exercises, gait training, and visual biofeedback than with the group 2 who received traditional physiotherapy treatment. A significant improvement was observed among group 1 which last one month after termination of the treatment. Results showed positive long lasting effect of the task specific exercises, gait training, and visual biofeedback on equinovrous gait pattern among individuals with stroke. [33]

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7. **Kamal Narayana "et al" 2012** conducted study to find the improvements in the upper extremity motor recovery of the patients who had a sub acute stroke using Meaning full Task specific training. 103 subjects with 4 to 12 weeks of post stroke were selected of the study subjects were randomized into 2 groups (MTST, 51; standard training group, 52). Subjects in the Brunnstrom stage of arm recovery of 2 to 5 were included in the study. Ninety-five participants completed the 8-week follow-up. Participants were assigned to receive either the MTST or dose-matched standard training program based on the Brunnstrom stage and Bobath neuro developmental technique, 4 to 5 days a week for 4 weeks. Outcome measures were measured using Fugl-Meyer assessment (FMA), Action Research Arm Test (ARAT), Graded Wolf Motor Function Test (GWMFT), and Motor Activity Log (MAL). The MTST group showed a positive improvement in the mean scores on the outcome measures at post and follow-up assessments in comparison to the control group. Further, statistically significant differences were observed in changes between the groups at post and follow-up assessment for FMA, ARAT, GWMFT, and MAL. The MTST

produced statistically significant and clinically relevant improvements in the upper extremity motor recovery of the patients who had a sub acute stroke. [34]

8. **Chayuri "etal" 2014** conducted study to investigate the effect of intensive gait training with rhythmic auditory stimulation on postural control and gait performance in individuals with chronic hemiparetic stroke.20 subjects with chronic hemiparetic stroke participated in this study. Subjects in the Rhythmic auditory stimulation training group (10 subjects) underwent intensive gait training with rhythmic auditory stimulation for a period of 6 weeks(30 min/day, five days/week),while those in the control group (10 subjects) underwent intensive gait training for the same duration. Two clinical measures, Berg balance scale and stroke specific quality of life scale, and a 2-demensional gait analysis system, were used as outcome measure. To provide rhythmic auditory stimulation during gait training,the MIDI Cuebase musical instrument digital interface program and a KM Player version 3.3 was utilized for this study. Intensive gait training with rhythmic auditory stimulation resulted in significant improvement in scores on the Berg balance scale, gait velocity, cadence, stride length and double support period in affected side, and stroke specific quality of life scale compared with the control group after training. Findings of this study suggest that intensive gait training with rhythmic auditory stimulation improves balance and gait performance as well as quality of life,in individuals with chronic hemi paretic stroke. [35]

9. **Langhammer B "et al" 2010** conducts study to compare motor re learning versus Bobath to improve quality of movement in subjects with stroke. A randomized controlled stratified trial of acute stroke patients. The patients were treated according to Motor Relearning Programme and Bobath approach and assessed with Motor Assessment Scale, Scoring Motor Evaluation Scale, Nottingham Health Profile and the Barthel Index. A triangulation of the test scores was made in reference to the Movement Quality Model and biomechanical, physiological, psycho-socio-cultural, and existential themes. The items arm ($p = 0.02–0.04$) sitting ($p = 0.04$) and hand ($p = 0.01–0.03$) were significantly better in the Motor Relearning Programme group than in the Bobath group, in both Scoring Motor Evaluation Scale and Motor Assessment Scale. Leg function, balance, transfer, walking and stair climbing did not differ between the groups. The Movement Quality Model and the movement qualities

biomechanical, physiological and psycho-socio-cultural showed higher scoring in the Motor Relearning Programme group, indicating better quality of movement in all items. Regression models established the relationship with significant models of motor performance and self reported physical mobility (adjusted R2 0.30–0.68, $p < 0.0001$), energy (adjusted R2 0.13–0.14, $p = 0.03–0.04$, emotion (adjusted R2 0.30–0.38, $p < 0.0001$) and social interaction (arm function, adjusted R2 0.25, $p = 0.0001$). These analyses confirm that task oriented exercises of the Motor Relearning Program type are preferable regarding quality of movement in the acute rehabilitation of patients with stroke.[36]

10. **Beverley French "et al" 2010** conducts study to Beverley French determine if repetitive task training after stroke improves functional activity. Systematic review and meta-analysis of trials comparing repetitive task training with attention control or usual care. 659 participants were included in the study and they are reviewed with Cochrane Collaboration methods, resources, and software. Results were statically analyzed for walking distance, walking speech, sit to stand and ADL. Repetitive task training resulted in modest improvement across a range of lower limb outcome measures, but not upper limb outcome measures. Training may be sufficient to have a small impact on activities of daily living. Interventions involving elements of repetition and task training are diverse and difficult to classify: the results presented are specific to trials where both elements are clearly present in the intervention, without major confounding by other potential mechanisms of action.[37]

11. **Gajanan Bhalerao "et al" 2013** conducted study to compare the effectiveness of Motor Relearning program (MRP) versus Bobath approach on Activities of Daily Living (ADL's) and ambulation at every two week's interval in Acute Stroke Rehabilitation in first six weeks of training. Randomized Control trial of 32 subjects with first unilateral stroke (middle cerebral artery territory involvement) participated in the study. Random allocation using block randomization in to two groups was done. Group A included 17 subjects received Motor Relearning Program (MRP) and Group B, 15 subjects received management based on Bobath approach for a period of six weeks. Functional Independence Measure and Barthel Index used for ADL's assessment and Functional ambulation category and Dynamic gait index for

ambulation performance. Motor relearning program showed significant improvement in Barthel Index. [38]

12. **Santos-Couto-Paz Cc "et al" 2015** conducted the study to find the addition of functional task-oriented mental practice to conventional physical therapy improves motor skills in daily functions after stroke. 9 individuals with stable mild and moderate upper limb impairments participated, by employing an A1-B-A2 single-case design. Phases A1 and A2 included one month of conventional PT, and phase B the addition of MP training to PT. The motor activity log (MAL-Brazil) was used to assess the amount of use (AOU) and quality of movement (QOM) of the paretic upper limb; the revised motor imagery questionnaire (MIQ-RS) to assess the abilities in kinesthetic and visual motor imagery; the Minnesota manual dexterity test to assess manual dexterity; and gait speed to assess mobility. After phase A1, no significant changes were observed for any of the outcome measures. However, after phase B, significant improvements were observed. The significant gains in manual dexterity and gait speed were maintained after phase A2. Specific functional task-oriented MP, when added to conventional PT, led to improvements in motor imagery abilities combined with increases in the AOU and QOM in daily functions, manual dexterity, and gait speed. [39]

13. **Straube Dd "et al" 2014** conducted study to find the Effects of dynamic stepping training on non locomotors tasks in individuals post stroke. Individuals with locomotor deficits following sub acute and chronic stroke (n=22) completed a locomotor training paradigm using a repeated-measures design. Practice of multiple stepping tasks was provided in variable environments or contexts at high aerobic intensities for ≥40 sessions over 10 weeks. The primary outcome was timed Five-Times Sit-to-Stand Test (5XSTS) performance, with secondary measures of sit-to-stand kinematics and kinetics, clinical assessment of balance, and isometric lower limb strength. Participants improved their timed 5XSTS performance following stepping training, with changes in selected biomechanical measures. Statistical and clinically meaningful improvements in balance were observed, with more modest changes in paretic leg strength. The present data suggested that significant gains in selected non-locomotor tasks can be achieved with high-intensity, variable stepping

training. Improvements in non practiced tasks may minimize the need to practice multiple tasks within and across treatment sessions. [40]

14. **Michael A. Gregory "et al" 2016** conducted a study on Group-based exercise combined with dual-task training improves gait but not vascular health in active older adults without dementia. Participants were randomized to either intervention. Each week, for 26 weeks, both groups accumulated 50 or 75 min of aerobic exercise from group-based classes and 45 min of beginner-level square stepping exercise (SSE). Participants accumulating only 50 min of aerobic exercise were instructed to participate in an additional 25 min each week outside of class. The EDT group also answered cognitively challenging questions while performing SSE (i.e., dual-task training). The effect of the interventions on gait and vascular health was compared between groups using linear mixed effects models. At 26 weeks, the EDT group demonstrated increased dual-task (DT) gait velocity, and carotid intima-media thickness, as well as reduced DT stride time variability,coefficient of variation percentage points, when compared to the EO group. Group-based exercise combined with dual-task training can improve DT gait characteristics in active older adults without dementia. [41]

15. **Sarah Richardson "et al"2015** conducted study to outline possible benefits in function from repetitive task-oriented training techniques and document outcomes of a patient who had received PT services >12 months post stroke. The patient was an 82 year-old female who was suffering from late effects of two separate stroke events. She was seen for outpatient PT for one hour, two times weekly for a total of 12 weeks during this episode of care. The following outcome measures were used: Function in Sitting Test (FIST), Tinetti, and a modified Gait Speed Test. Outcomes: Improvements in balance and functional mobility on the Tinetti (4/28 to 16/28) and Function in Sitting Test (43/56 to 56/56) were noted. Improved strength was noted based on manual muscle testing of the quadriceps and hamstrings. This patient was able to achieve independent bed mobility, increase her walking distance, and decrease the level of gait assistance needed (from max to contact guard) with improved quality of gait. No significant changes were noted in gait speed. Modified Ashworth Scale indicated no change in spasticity. Discussion: The findings suggest that a task-oriented approach to physical therapy intervention may have been a feasible method

for this individual with chronic effects of stroke. Further research is needed to validate these results for similar patients. [42]

2.3 REVIEW FOR PROPRIOCEPTIVE NEURO MUSCULAR FACLITATION:

16. **Bhaleraogajanan "et al"2015** conducted a study on various neurophysiologic approaches like Proprioceptive neuromuscular facilitation technique i.e. PNF, Bobath's neurodevelopment approach i.e. NDT, Brunnstrom technique and Rood's approach. But there is a lot of variation of use of these approaches depending on the therapists. We wanted to find the approach is used the most, what was the reason behind the selection, and were the physiotherapists trained in it. It is questionnaire based survey, validated by 3 clinical experts, created using Google docs and was emailed to more than 2000 therapists across India. Out of which 412 therapists willingly participated in the survey. Ten incomplete questionnaires were excluded. Final sample size was 402. The questionnaire was based on the neuro therapeutic approaches. Physiotherapists holding BPTh and MPTh degrees were included in the study. After the reception of responses the data was analyzed through descriptive analysis. Out of all the respondents, 15% of them were on-going masters students while rest all of them were clinicians. This included 39% from south and west region each and 13% from north and 9% from east region of India. The study shows that 96% therapist show good awareness about the approaches, despite this 73% faced difficulty practicing it. Although PNF, sensory integration, CIMT, MRP are found to be most commonly taught at graduation level followed by Rood, NDT/Bobath and Brunnstorm, PNF and CIMT are most commonly preferred and practiced approaches, followed by NDT/Bobath and Brunnstorm. The least preferred and practiced approaches were found to be Roods and Motor Relearning Program. It was found that the therapists misunderstood sensory integration with sensory re-education. PNF and CIMT were more preferred because they are easy to learn and practice and are also evidence based. Only 13% of therapists were found to have received training in some approaches. Surprisingly, 90% of them were found to be interested in attending additional training in these approaches.96% of therapists are well aware of neuro approaches, but face difficulty practicing them. PNF and CIMT are most commonly preferred and practiced approaches, followed by NDT and Brunnstorm and Roods and

MRP. There is a mix pattern of practice of traditional approaches such as PNF, Brunnstorm and NDT and the task specific training such as CIMT. This study suggests that the physiotherapists are still practicing more of traditional approaches than task specific approaches such as CIMT and MRP. The study further shows that majority of the therapists i.e.87% have not had any additional training and that 90% are keen on acquiring additional knowledge about these approaches through some workshop or a seminar [43]

17. **Seo Kc "et al" 2015** Conducted study to examine the effects of ramp gait training using lower extremity patterns of Proprioceptive neuromuscular facilitation (PNF) on chronic stroke patients' dynamic balance ability. [Subjects and Methods] In total, 30 stroke patients participated in this study, and they were assigned randomly and equally to an experimental group and a control group. The experimental group received exercise treatment for 30 min and ramp gait training with PNF for 30 min. The control group received exercise treatment for 30 min and ground gait training for 30 min. The interventions were conducted in 30 min sessions, three times per week for four week. The subjects were assessed with the Berg balance scale test, timed up and go test, and functional reach test before and after the experiment and the results were compared. After the intervention, the BBS and FRT values had significantly increased and the TUG value had significantly decreased in the experimental group; however, the BBS, FRT, and TUG values showed no significant differences in the control group. In addition, differences between the two groups before the intervention and after the intervention were not significant.In conclusion, ramp gait training with PNF improved stroke patients' dynamic balance ability, and a good outcome of ramp gait training with PNF is also expected for other neurological system disease patients.[44]

18. **Kim Ek "et al" 2015** conducted the study to investigate the effect of aquatic Proprioceptive neuromuscular facilitation (PNF) patterns in the lower extremity on balance and activities of daily living (ADL) in stroke patients. [Subjects] Twenty post stroke participants were randomly assigned to an experimental group (n = 10) or a control group (n = 10). The experimental group performed lower extremity patterns in an aquatic environment, and the control group performed lower extremity patterns on the ground. Both exercises were conducted for 30 minutes/day, 5 days/week for 6

weeks. Balance was measured with the Berg Balance Scale (BBS), Timed Up and Go Test (TUGT), Functional Reach Test (FRT), and One Leg Stand Test (OLST). Activities of daily living were measured with the Functional Independence Measure (FIM). A paired t-test was used to measure pre- and post-experiment differences, and an independent t-test was used to measure between-group differences. The experimental and control groups showed significant differences for all pre- and post-experiment variables. In the between-group comparison, the experimental group was significantly difference from the control group. These results indicate that performing aquatic Proprioceptive neuromuscular facilitation patterns in the lower extremity enhances balance and ADL in stroke patients.[45]

19. **Co Akosile "et al" 2011** conducted study to investigate the effect of an 8-weekproprioceptive neuromuscular facilitation (PNF)treatment program on the functional ambulation of post-stroke individuals measured with the Emory Functional Ambulation Profile (EFAP) - a timed-test instrument comprising 5 subtasks. Seventeen male and female post-stroke individuals (mean age56.73+8.79years) were recruited into the study and treated with a PNF protocol twice weekly for 8 weeks. Performance on individual subtasks of the EFAP were measured and recorded for each participant before and at the end of the study. Only the data for 15participants was available at the post-test for analysis. EFAP subtasks completion times were significantly reduced for all subtasks at the post-test and total EFAP score ($p<0.05$). PNF technique led to improvement in the functional ambulation of post stroke individuals. PNF is recommended as an effective treatment for functional ambulatory gains in stroke rehabilitation.[46]

20. **Dildip Khanal "et al" 2013** conducted study to find Effectiveness of Pelvic Proprioceptive Neuromuscular Facilitation Technique on Facilitation of Trunk Movement in Hemiparetic Stroke Patients Thirty hemiparetic stroke patients were randomly divided into two groups. The experimental group received pelvic PNF while the control group received conventional physiotherapy in the form of trunk exercises for 30 minutes. Along with this both group received regular physiotherapy in the form of tonal management and range of motion exercises for the affected limbs for 30 minutes. Intervention was given once in a day for five days/week for four weeks. Outcome Measures were assessed using Trunk Impairment Scale (TIS), Trunk Lateral

Flexion Range of Motion (TLF ROM), and Tinetti Test (TT). Post-intervention, both the group shows improvement on trunk performance, range of motion, balance and gait but the experimental group shows more improvement than control group. [47]

21. **Tatiana Souza Ribeiro "et al" 2014** Conducted study to analyze the effects of a training program based on the Proprioceptive Neuromuscular Facilitation (PNF) method on motor recovery of individuals with chronic post-stroke hemiparesis. Eleven individuals with chronic hemiparesis (mean lesion time of 19.64 months) after unilateral and non-recurrent stroke underwent training based on PNF method for twelve sessions, being evaluated for motor function - using the Stroke Rehabilitation Assessment of Movement (STREAM) instrument; functionality, by the Functional Independence Measure (FIM); and gait kinematic (using the Qualisys Motion Capture System), at baseline and post-training. Significant changes in FIM were observed. Data showed significant changes in motor function and functionality after training, suggesting that this program can be useful for rehabilitation of chronic stroke survivors. [48]

22. **Kumar "et al 2012"** conducted study to find The Effect of PNF Technique on Gait Parameters and Functional Mobility in Hemiparetic Patients 30 subjects affected by cerebrovascular accident of ischemic injury took part in the study. They were divided into two groups i.e. an Experimental group and a Control group with 15 patients in each group. The subjects of this study were the residents of northern Haryana and the mean age of the patients was 59 to 30 years. Patients were assessed before commencement and after the completion of treatment sessions by a fixed battery of tests on Stride length, Gait Velocity, Cadence and Functional Mobility parameters with measuring tape, stop watch and Rivermead Mobility Index respectively. The results of this study demonstrated that the PNF technique has significant effect on gait parameters & functional mobility as compared to conventional therapy in patients with hemiplegia. The findings show that the walking speed has a significant effect on functional mobility in stroke patient. [49]

23. **Chaturvedi Poonam et al"2015"** conduct a study To find correlation of lesion volume with functional outcome and effects of PNF (Proprioceptive Neuromuscular Facilitation) exercises in the improvement of functional outcome in the patients having MCA ischemic stroke. The study is a randomized controlled pilot study. 20 subjects having first time ischemic MCA stroke were recruited and their lesion volumes were calculated from CT scan. Subjects were divided into two equal groups: experimental (gp. A) and control (gp. B). Experimental group were given PNF exercises and control group were given general exercises. Barthel Index and Fugl-Meyer scale were assessed before and after the intervention. Data was analyzed by using student t- test by SPSS version 16.0. There is negative correlation between lesion volume and Barthel Index; and between lesion volume and Fugl- Meyer scale.. The patients receiving PNF showed improvement in functional outcome more than control group. [50]

REVIEW FOR EXTENDED TIMED UP AND GO TEST

24. **Pernille Botolfsen "et al" 2008** conducted a study to find the Reliability and concurrent validity of the Expanded Timed Up-and-Go test in older people with impaired mobility. The present study is reliability and a validity study. Twenty-eight subjects (80 ± 4.1 years) with balance and gait problems were included. Three raters timed the ETUG subtasks from a video, using a computer-based scoring programme, and the total ETUG time was calculated. TUG was registered by a regular stopwatch. The ETUG scored from a video shows a good reliability for experienced raters and acceptable internal consistency. The ETUG showed a higher reliability than TUG when tested on the same sample of older subjects with impaired mobility, and the high concurrent validity between ETUG and TUG suggests that the two tests may have similar properties. Since ETUG also adds new information compared with TUG, we suggest that ETUG is an interesting alternative to existing clinical tests of mobility. [51]

25. **Christina D. Faria, "et al" 2012** conducted a study to investigate the intra- and inter rater reliabilities of the Expanded Timed Up and Go (ETUG) test with subjects with stroke and to compare the ETUG scores between subjects with stroke and healthy control subjects. 48 Stroke participants and 48 healthy controls, matched by age, sex,

and levels of physical activity were included in the study. Subjects with stroke spent more time in all of the ETUG activities when compared with control subjects. All of the activities appeared to contribute similarly to the poorer performances observed in subjects with stroke, because the ratio values were similar between the groups. Considering the positive intra- and inter rater reliability results, the ETUG could be applied to assess the functional mobility of both groups [52]

CHAPTER III

MATERIALS AND METHODOLOGY

3.1 MATERIALS

- Couch
- Parallel bars
- Stepping board
- Foot stool
- Mirror
- Ball
- Tray
- Walk way with chart instruction described
- Chair with arm rest and without arm rest
- Stop watch

3.2 METHODOLOGY

3.2.1 Study design:

The study design was experimental study design.

3.2.2 Sampling size:

Sample of 30 subjects who came under selection criteria were included in the study.

3.2.3 Sampling method:

Convenient sampling technique and randomly allocated.

3.2.4 Study duration:

The study duration was 12 weeks.

3.2.5 Study method:

Subjects were divided into control group and experimental group

Control group:

15 subjects are treated with conventional therapy along with Proprioceptive neuromuscular facilitation

Experimental group:

15 subjects are treated with conventional therapy along with PNF and motor relearning

3.2.6 Selection criteria:

Inclusive criteria:

- Both male and female
- Age 35-45
- Burn storm recovery stage 3, 4
- Dominant side hemiplegic subjects

Exclusive criteria:

- Perpetual and Cognitive deficits
- Recent surgery of lower limb
- Associated neurological problems like Parkinsonism.
- Any fixed deformity
- Severe respiratory distress and cardiac involvement.
- Medical instability

3.2.7 Study setting:

- Bone and joint physiotherapy and rehabilitation clinic, Salem.

3.2.8 Study duration:

The treatment will be scheduled according to the clinical standards and the subjects in control groups will be given 30 min of PNF along with conventional therapy and subjects in experimental group will be given 30 min of PNF along with conventional therapy and 20 min of Task training program. The treatment will be given 3 times in a week in alternate days for 12 weeks.

3.2.9 Parameter:

Outcome measures:

- Extended Timed Up and Go Test (ETUG).

3.2.10 TREATMENT TECHNIQUE:

PROPRIOCEPTIVE NEUROMUSCULAR FACLITATION) :

- Rhythmic initiation of pelvic
- Slow reversal of pelvic
- Agonistic reversal of pelvic

PNF elements such as manual contact, stretch, resistance, and verbal cuing were incorporated along with the treatment.

Frequency: 30 min/ session/day.

MOTOR RE LEARNNG PROGRAMME:

TASK SPECIFIC LOCOMOTORS TRAINING:

Sitting to standing:

- With arm rest chair
- Without arm rest chair

Walking:

- Walking forward with eye open and closed
- Walking backward with eye open and closed
- Walking sideward with eye open and closed

Crossed stepping:

- Side stepping

Elevation activities:

- Step up
- Step down
- Lateral step ups
- Stair climbing
- Step over step

Community activities:

- Walking on ramps
- Walking on curbs
- Walking on uneven terrain
- Walking over and around obstacles

Balance activities:

- Tandem walking on a line
- Semi-tandem walking
- Walking on a foam

Dual task activities:

- Holding a ball and walk
- Carrying a tray over head and walk
- Carrying on a conversation and walk

Coincident timing required:

- Walking to the doors
- Walking across the room

Frequency: 20 min/ session/day.

CONVENTIONAL THERAPY:

- Stretching.
- Strengthening exercise:
    - Pelvic bridging.
    - Active assisted mobilization.
    - Active mobilization with minimal and maximal resistance.
    - Bed transference training.
    - Upper limb and Lower limb exercises in sitting and standing position with and without resistance.

3.2.11 Study Procedure:

After getting informed consent, checking inclusion and exclusion criteria under convenient sampling technique 30 subjects were selected and randomly assigned into control group and experimental group.

Group A will consist of 15 subjects (control group), Group B will consist of 15 subjects (Experimental group). Both the control group and experimental group will receive clear explanation in detail about the study.

The subjects in Group A (control group) will be given Proprioceptive neuromuscular facilitation as per the protocol, all subjects will receive a protocol of 3 PNF techniques i.e. rhythmic initiation, slow reversal and agonistic reversal for pelvis for 30min for 3 days for alternate days in a week for a total duration of 4 weeks (12 sessions). Each technique will be given for 10 minutes.

These procedures were done to facilitate anterior tilt and posterior tilt of pelvis in a side lying position. The elements of PNF, such as manual contact, stretch, resistance, and verbal cuing were incorporated into the treatment scheme.

The subject will be doing the conventional therapy as a home exercise everyday and also during the session

The subjects in Group B (EXPERIMENTAL GROUP) will be given PNF and conventional therapy along with motor relearning as per protocol, all subjects received MRP for 20min along with PNF. Task training program will be used to assign the motor re-learning program; the protocol was designed according to the clinical standards in the MRP.

The subject will be doing the conventional therapy as a home exercise everyday and also during the session

The results are obtained through the extended timed up-go test (ETUG) [51, 52] and the timings for each task were recorded using stop watch for pre- test and post-test in both control and experimental group, and the conclusion were made.

CHAPTER IV

DATA ANALYSIS AND RESULTS

The study comprised of two groups, control group and experimental group, with 15 subjects in each group. For the both group age range was between 45 and 55. Statistics was done by using SPSS.17 version.

The paired t test was used for within group analysis. Pre and post mean with standard error mean, t values and p values of control group for ETUG components sit to stand, walk 1, turn, walk 2, turn sit, walk speed are given in the table1. Their p value was 0.00. The result showed there were significant improvement in within group analysis for control group.

TABLE I

WITHIN CONTROL GROUP ANALYSIS

COMPONENT OF ETUG	PRE MEAN VALUE ± STANDARD ERROR MEAN	POSTMEAN VALUE± STANDARED ERROR MEAN	t VALUE	SIGNIFICANCE (p VALUE)
SIT TO STAND	10.1200 ±0.20545	7.5200±0.22640	21.469	0.0
WALK 1	10.7600±0.11580	8.5667±0.19752	9.234	0.0
TURN	9.8533±0.22822	7.5533±0.22036	35.133	0.0
WALK 2	11.4600±0.2466	8.8933±0.23227	11.259	0.0
TURN & SIT	10.4067±0.34219	7.6733±0.28174	14.587	0.0
WALKSPEED	52.6000±0.51594	40.2067±0.69189	29.077	0.0

For experimental group pre and post mean with standard error mean, t values and p values of experimental group for ETUG components sit to stand, walk 1, turn, walk 2, turn sit, walk speed were given in the table 2. Their p values are calculated to be 0.00 through SPSS version 17. The result showed there was significant improvement in within group analysis for experimental group.

TABLE II

WITHIN EXPERIMENTAL GROUP ANALYSIS

COMPONENT OF ETUG	PRE MEAN VALUE ± STANDARD ERROR MEAN	POSTMEAN VALUE± STANDARED ERROR MEAN	t VALUE	SIGNIFICANCE (p VALUE)
SIT TO STAND	10.3733 ±0.14225	5.8000±0.16036	19.795	0.0
WALK 1	11.0933±0.19651	5.8000±0.17968	21.500	0.0
TURN	10.0067±0.2588	5.06673±0.15096	15.985	0.0
WALK 2	10.3467±0.34598	5.3000±0.12459	14.343	0.0
TURN & SIT	10.5267±0.29592	4.6800±0.11050	18.189	0.0
WALKSPEED	52.3467±0.78527	26.6467±0.42391	26.858	0.0

Unpaired t test was used to compare the pre – post values of both the group. The pre test values of both the control and experimental group for the ETUG components sit to stand, walk 1, turn, walk 2, turn sit, walk speed outlining the f value and p value were given in table 3. The result showed that there was no homogenisity among the group.

TABLE III

INTRA GROUP ANALYSIS PRE VALUES

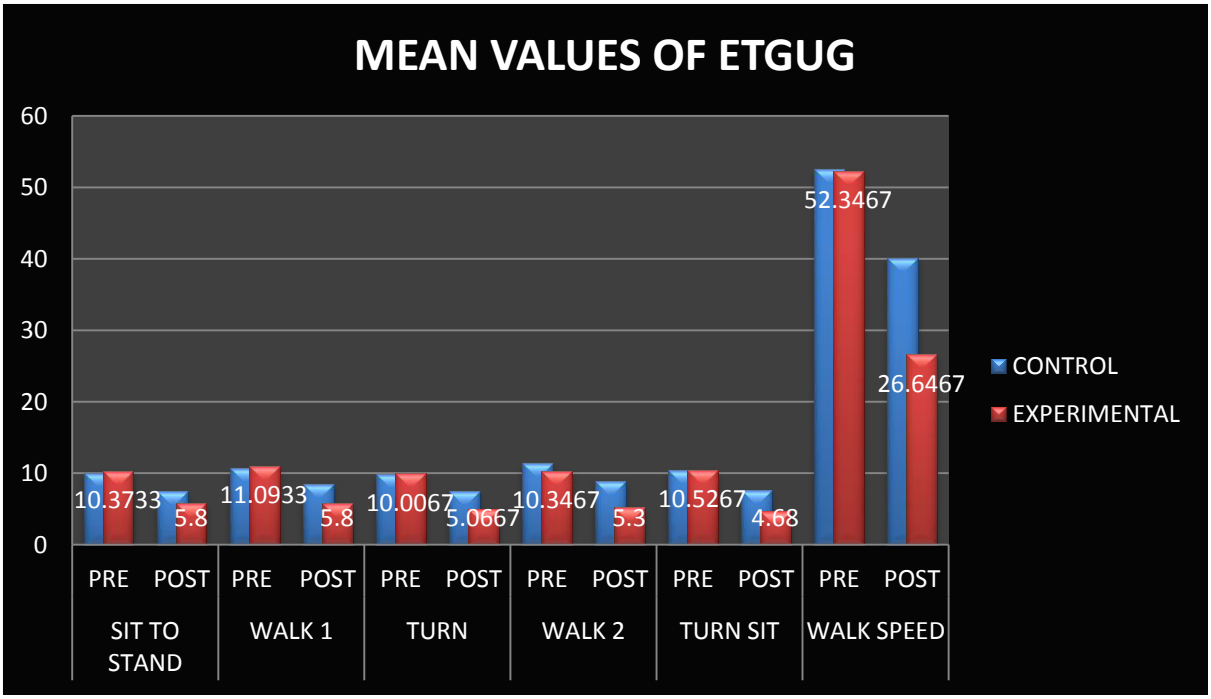
COMPONENTS OF ETUG	CONTROL PRE MEAN VALUE ± STANDARD ERROR MEAN	EXPERIMENTAL PRE MEAN VALUE ± STANDARD ERROR MEAN	F VALUE	SIGNIFICANCE 'p' VALUE
SIT TO STAND	10.1200 ±0.20545	10.3733 ±0.14225	3.310	0.88
WALK 1	10.7600±0.11580	11.0933±0.19651	5.615	0.25
TURN	9.8533±0.22822	10.0067±0.2588	0.182	0.673
WALK 2	11.4600±0.2466	10.3467±0.34598	3.008	0.094
TURN & SIT	10.4067±0.34219	10.5267±0.29592	.280	0.601
WALKSPEED	52.6000±0.51594	52.3467±0.78527	2.137	0.155

The post test values of both the group were calculated. The mean values, F value and p value of ETUG components sit to stand, walk 1, turn, walk 2, turn sit, walk speed are given in table 4. The result showed that there were significant difference between control and experimental group in walk2 and turn to sit components only. Remaining components were not significant. It concludes that the experimental group showed good improvement than the control group.

TABLE IV

INTRA GROUP ANALYSIS POST VALUES

COMPONENTS OF ETUG	CONTROL POST MEAN VALUE ± STANDARD ERROR MEAN	EXPERIMENTAL POST MEAN VALUE ± STANDARD ERROR MEAN	F VALUE	SIGNIFICANCE 'p' VALUE
SIT TO STAND	7.5200±0.22640	5.8000±0.16036	2.208	0.165
WALK 1	8.5667±0.19752	5.8000±0.17968	0.196	0.662
TURN	7.5533±0.22036	5.06673±0.15096	2.389	0.133
WALK 2	8.8933±0.23227	5.3000±0.12459	4.731	0.038
TURN & SIT	7.6733±0.28174	4.6800±0.11050	8.217	0.008
WALKSPEED	40.2067±0.69189	26.6467±0.42391	3.953	0.057


MEAN VALUES OF ETGUG
60
50
40
30
20
10
0
10.3733
5.8
11.0933
5.8
10.0067
5.0667
10.3467
5.3
10.5267
4.68
52.3467
26.6467
PRE
POST
SIT TO STAND
WALK 1
TURN
WALK 2
TURN SIT
WALK SPEED
CONTROL
EXPERIMENTAL

CHAPTER V

DISCUSSION

Stroke leads the patients to completely dependency with loss of sensory, motor, perpetual, and cognitive deficits. Functional mobility is altered following stroke owing to various factors. Inability to perform the functional mobility like walking, sitting, standing, and turning is common in stroke patients. PNF along MRP are rarely used in improving functional mobility of stroke patients.

Proprioceptive neuromuscular facilitation developed by Herman Kabat is a ongoing analysis of sensorimotor function and carefully planned intervention designed to improve functional mobility. The synergic patterns and methods involved have a great effect on improving functional mobility and motor function. Janet and carr shepered stated that moor relearning has a set of internal process associated with practice and experience leading to permanent changes in the capability for skilled behaviour. I involves significant amount of practice and feedback with high level of information processing related to control error detection and correction.

A study by RAJESH VERMA "ET AL" 2011 with 30 post stroke patients concluded that physical therapy programming using task oriented training in MRP improves the functional mobility and gait related activities which supports this study on improving functional mobility.

A study by KIM EK "ET AL" 2015 with 20 post stroke participants conclude that PNF is effective in improving ADL and enhance balance. In recent past a study by NWE NI THEIN et al"2014" concluded that both motor relearning and PNF showed a good result in

maintaining trunk balance, this insisted to make a study by implicating PNF along with MRP to improve functional mobility in sub acute stroke subjects.

With the support of past evidences there are many study to show their individuality in improving functional mobility unfortunately there not much studies on improving functional mobility by using PNF along with MRP the present study was designed to show that PNF along with MRP is more significant on improving functional mobility in hemiplegic patients. We need further research to provoke the early recovery using PNF along with MRP on functional mobility. Hence PNF along with MRP may be helpful in improving the functional mobility in hemiplegic patients.

Even though there are evidences for reliability and concurrent validity for ETUG [51, 52] there is not much supporting articles and evidences for evaluating functional mobility for stroke subjects using the components of ETUG, the study will evaluate the hypothesis from the obtained values.

In this study the result highlighted that there is significant difference for ETUG components walk2 and turn sit. The reason may be the patient had some delay in the initiation of the ETUG component and adopted in the later part.

CHAPTER VI

SUMMARY AND CONCLUSION

Summary:

In an effort to find out the effectiveness of PNF along with MRP in improving functional mobility in sub acute stroke subjects, 30 subjects were selected using convenient sampling technique and randomly allocated in to two groups with 15 subject each.

Control group was treated with PNF and experimental group was treated with PNF along with MRP for a period of 4 weeks.

The results were analysed using paired‘t’ test and un paired‘t’ test which favoured the alternate hypothesis.

Conclusion:

It can be conclude that PNF along with MRP shows significant improvement than PNF alone in improving the functional mobility of stroke patients.

CHAPTER VII

LIMITATION AND SUGGESTION

- The study was very short term study and therefore to make the result more valid long term study should be done
- This study has been done with smaller samples and hence further studies should be conducted with larger sample
- This study should be analysed using various other profiles and scales like ETGUG, Modified ETUG, Functional ambulation profile (FAP), Functional independent measures (FIM), etc,
- Variation in climate, drugs, diet, personal habit, side of involvement, gender, age could not be controlled.
- Dominant side is included in this study can be done over non dominant side involvement in further studies.

CHAPTER VIII

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CHAPTER IX

APPENDIX – I

CASE ASSESMENT PROFORMA

CASE NO :

NAME :

SEX :

ADDRESS :

DATE OF ADMISSION :

DATE OF EVALUATION :

HISTORY :

ON OBSERVATION :

ON EXAMINATION :

TREATMENT : PNF AND MOTOR RELEARNING

MEASURMENT TOOL : ENTENDEDN TIMED UP AND GO TEST

COMPONENTS	SIT TO STAND	WALK 1	TURN	WALK 2	TURN & SIT	WALKSPEED
PRE TEST						
POST TEST						

Signature of physical therapy student

APPENDIX II

PATIENT CONSENT FORM

TITLE: "EFFECTIVENESS OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION ALONG WITH MOTOR RE-LEARNING ON IMPROVING FUNCTIONAL MOBILITY IN SUBJECTS WITH SUB-ACUTE STROKE"

INVESTIGATOR: _____

PURPOSE OF THE STUDY:

I _____, have been informed that this study will work towards improving functional mobility in sub-acute stroke conditions for me and other patients.

PROCEDURE:

Each term of study protocol has been explained to me in detail. I understand that during the procedure, I will be receiving the treatment for one time a day. I understand that i will have to take this treatment for four weeks.

I understand that this will be done by the investigator, _____ supervision. I am aware that I have to follow therapist's instruction that has been told to me.

CONFIDENTIALITY:

I understand that medical information provided by this study will be confidential. If the data are used for publication in the medical literature or for teaching purpose, no name will be used and other literature such as audio or video tapes will be used only with permission.

RISK AND DISCOMFORT:

I understand that there are no potential risk associated with this procedure, and understand that investigator will accompany me during this procedure. There is no known hazard associated with this procedure.

REFUSAL OR WITH DRAWL OF PARTICIPATION:

I understand that the decision of my participation is voluntary and I may refuse participate, may withdrawal consent at any time during the study.

I also understand that the investigator may terminate my participation in the study at any time after the researcher has explained me the reason to do so.

I _____ have explained to _____ the purpose of the research, the procedure required and the possible risks and benefits, to the best of my ability.

_____ _____

Investigator **Date**

I _____ confirm that the researcher has explained me the purpose of the research, the study procedure and the possible risk and benefits that I may experience. I have read and I have understood this consent to participate as a subject in this research project.

_____ _____

Subject Date

_____ _____

Signature of the witness Date

APPENDIX III

Brunnstrom stages of recovery

STAGE	DESCRIPTION
1	Immediately following a stroke there is a period of flaccidity whereby no movement of the limbs on the affected side occurs.
2	Recovery begins with developing spasticity, increased reflexes and synergic movement patterns termed obligatory synergies. These obligatory synergies may manifest with the inclusion of all or only part of the synergic movement pattern and they occur as a result of reactions to stimuli or minimal movement responses.
3	Spasticity becomes more pronounced and obligatory synergies become strong. The patient gains voluntary control through the synergy pattern, but may have a limited range within it.
4	Spasticity and the influence of synergy begins to decline and the patient is able to move with less restrictions. The ease of these movements progresses from difficult to easy within this stage.
5	Spasticity continues to decline, and there is a greater ability for the patient to move freely from the synergy pattern. Here the patient is also able to demonstrate isolated joint movements, and more complex movement combinations.
6	Spasticity is no longer apparent, allowing near-normal to normal movement and coordination.

APPENDIX IV

SCORING THE ETUG

COMPONENTS	SIT TO STAND	WALK 1	TURN	WALK 2	TURN & SIT	WALKSPEED
PRE TEST						
POST TEST						

Each subtask was instructed in the same way: 'After I have counted three, two, one, I want you to start. Are you ready? Three, two, one, start'.

Subtask 1: Sit-to-Stand

The subjects sat on a 46-cm high chair with armrests with their back against the back of the chair. The instruction was to rise to an upright position and stand still. There was no instruction on the use of armrests, but whenever used, it was recorded. The time

was started at the instruction 'start' and stopped when the subject was standing upright and still.

Subtask 2: Walk 1

The subjects were asked to walk a distance of 6 m at their preferred gait speed and then stop without turning. Time was recorded for the middle 3 m. Start and stop times were registered when the subject's hips/body passed two lines on the floor, one at the beginning and the other at the end of the central 3-m region of the walkway.

Subtask 3: Turn

At the start of the 180° turn, the subjects stood with their back against the walkway. Time was taken from the instruction 'start' until the subjects had turned 180° and were standing still, facing the walkway and the chair.

Subtask 4: Walk 2

The subjects were asked to walk a distance of 6 m at their fast but safe speed and then stop without turning. Time was recorded for the middle 3 m. Start and stop times were registered when the subject's hips passed two lines on the floor, one at the beginning and the other at the end of the central 3-m region of the walkway.

Subtask 5: Turn and Sit

The subjects stood in front of and facing the chair and were instructed to turn and sit down. Time was registered from the instruction 'start' until the subjects were sitting on the chair.

Walk speed:

The ETUG total time was calculated by adding up the time for all five subtasks: sit- stand, walking at preferred speed, 180° turn, walking at fast speed, and turn and sit down.